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Preoperative Prediction For Risk Factors Of Readmission After Total Joint Replacement Surgery

Naveed Khan^{1*}, Hamdoon Suharwardy Asim², Syed Alam Zeb³, Ali Amjad⁴, Osama Bin Zia⁵, Syed Abdur Rub Abidi⁶, Nusrum Iqbal⁷, Tauseef Raza⁸

¹*Assistant Professor, Department of Orthopedic Surgery, Medicare Cardiac and General Hospital, Karachi

²Senior House Officer, Department of Trauma & Orthopedics, Sligo University Hospital, Ireland

³Specialty Registrar, Aneurin Bevan University Health Board, Newport, UK

⁴Registrar, Aneurin Bevan University Health Board

⁵Assistant Professor, Department of Orthopedic Surgery, Liaquat College of Medicine and Dentistry, Darul Sehat Hospital, Karachi

⁶Associate Professor, Orthopaedic Surgery Department, Jinnah Medical & Dental College Karachi

⁷Chairman Department of Internal Medicine, MD Health Center, Lahore

⁸Assistant Professor, Orthopedic Department of KMU Institute of Medical Sciences Kohat, DHQ Teaching Hospital

***Corresponding Author:** Naveed Khan

*Email: Drkhannaveed@gmail.com

Abstract

Introduction: Total joint replacement surgery has revolutionized the management of debilitating joint conditions, offering patients renewed mobility and relief from pain.

Objective: The main objective of the study is to find the preoperative prediction for risk factors of readmission after total joint replacement surgery.

Methodology of the study: This observational study was conducted at Medicare Cardiac and General Hospital from January 2021 to January 2023. A cohort of 80 patients who underwent total joint replacement surgery were included in the study. Patients were selected based on the availability of complete preoperative and postoperative data, ensuring a comprehensive dataset for analysis. Preoperative data, including demographic information, clinical characteristics, and surgical details, were meticulously collected from electronic medical records.

Results: Data were collected from 80 patients of joint replacement surgery. Mean age of the patients was 56.3 ± 2.35 years and mean BMI was 29.1 ± 1.89 kg/m². 38% shows diabetes and 46% shows hypertension alongside replacement therapy. 60% of the patients undergoes knee replacement therapy and 40% hip replacement therapy. Sensitivity and specificity were balanced, with values of 0.70 and 0.80, respectively, indicating the model's ability to correctly identify both positive and negative cases of readmission risk. Additionally, the model exhibited a Positive Predictive Value (PPV) of 0.65 and a Negative Predictive Value (NPV) of 0.85, reflecting its utility in predicting readmission outcomes.

Conclusion: It is concluded that developed preoperative prediction model offers a valuable tool for identifying patients at higher risk of readmission after total joint replacement surgery.

Introduction

Total joint replacement surgery has revolutionized the management of debilitating joint conditions, offering patients renewed mobility and relief from pain. However, despite advancements in surgical techniques and perioperative care, hospital readmissions following these procedures remain a significant concern. Such readmissions not only impose substantial financial burdens on healthcare systems but also affect patient outcomes and satisfaction [1]. Thus, in respect to some aspects, various researches developed statistical risk stratification models for 30- and 90-day readmission after joint arthroplasty. It is nonetheless rare to find these studies reporting on these specifics that contrast with gold standards to evaluate underlying risk factors among the implicated studies or to jointly establish their impact on orthopaedics practice [2]. THR is highly recommended for treatment of hip arthritis, osteonecrosis or hip fracture, and is the most prevalent orthopedic surgery in United States patients to relieve pain and enable better functioning. Preoperative medical assessment traditionally reveals how 'fit' a candidate is for anaesthesia and surgery. Since the focus of payment reform has shifted toward value-based care, particularly moving toward bundled payments, interests in avoiding risk factors leading to poor outcomes have grown [3]. First, total joint arthroplasty (TJA) which for the purpose of this review incorporates both THA and TKA is an elective operation, and therefore patient risk factors that could be altered preoperatively offer much possibility for optimization. These are crucial approaches in making certain safety, decrease of complications and an optimum of useful final results [4]. Prior research has highlighted the

prevention and control of potential modifiable risk factors for TJA patients that enhance the risk of complications; these include deep and superficial infections, pulmonary emboli, and myocardial infarction [5]. These include notably, risk factors that could be potentially changed and modified as they correlate with readmissions, protracted length of stay, costs, and revision. In recent years, there has been a growing interest in developing preoperative prediction models to identify patients at higher risk of readmission after total joint replacement surgery [6]. These models utilize a combination of patient demographics, clinical characteristics, comorbidities, and procedural factors to stratify patients based on their likelihood of experiencing postoperative complications necessitating readmission [7]. The development and validation of such prediction models are crucial steps towards personalized preoperative risk assessment, enabling healthcare providers to implement targeted interventions and optimize care pathways for high-risk patients [8]. By identifying individuals who may benefit from closer postoperative monitoring, early intervention, or tailored rehabilitation programs, these models have the potential to improve patient outcomes and reduce healthcare costs associated with preventable readmissions [9].

Objective

The main objective of the study is to find the preoperative prediction for risk factors of readmission after total joint replacement surgery.

Methodology of the study

This observational study was conducted at Medicare Cardiac and General Hospital from January 2021 to January 2023. A cohort of 80 patients who underwent total joint replacement surgery were included in the study. Patients were selected based on the availability of complete preoperative and postoperative data, ensuring a comprehensive dataset for analysis. Preoperative data, including demographic information, clinical characteristics, and surgical details, were meticulously collected from electronic medical records. Similarly, postoperative data regarding hospital readmissions within 30 days following surgery, along with reasons for readmission and length of stay, were obtained from hospital databases, ensuring a robust dataset for model development. Potential predictors of readmission were identified through a thorough review of the literature and consultation with clinical experts. Variables such as age, BMI, comorbidities, surgical complexity, and perioperative complications were considered for inclusion in the prediction model, ensuring a comprehensive assessment of factors influencing readmission risk. Statistical analyses were conducted using SPSS, employing a significance level of $p = 0.05$ for hypothesis testing.

Results

Data were collected from 80 patients of joint replacement surgery. Mean age of the patients was 56.3 ± 2.35 years and mean BMI was 29.1 ± 1.89 kg/m². 38% shows diabetes and 46% shows hypertension alongside replacement therapy. 60% of the patients undergoes knee replacement therapy and 40% hip replacement therapy.

Table 01: Demographic data of patients

Variable	Value
Age (years)	56.3 ± 2.35
BMI (kg/m ²)	29.1 ± 1.89
Comorbidities	
- Diabetes	38%
- Hypertension	46%
Surgical Type	
- Knee	60%
- Hip	40%
Perioperative Complications	0.25

Sensitivity and specificity were balanced, with values of 0.70 and 0.80, respectively, indicating the model's ability to correctly identify both positive and negative cases of readmission risk. Additionally, the model exhibited a Positive Predictive Value (PPV) of 0.65 and a Negative Predictive Value (NPV) of 0.85, reflecting its utility in predicting readmission outcomes.

Table 02: Performance of readmission model

Model Metric	Value
Area Under ROC Curve (AUC)	0.75
Sensitivity	0.70
Specificity	0.80
Positive Predictive Value (PPV)	0.65
Negative Predictive Value (NPV)	0.85
Accuracy	0.75

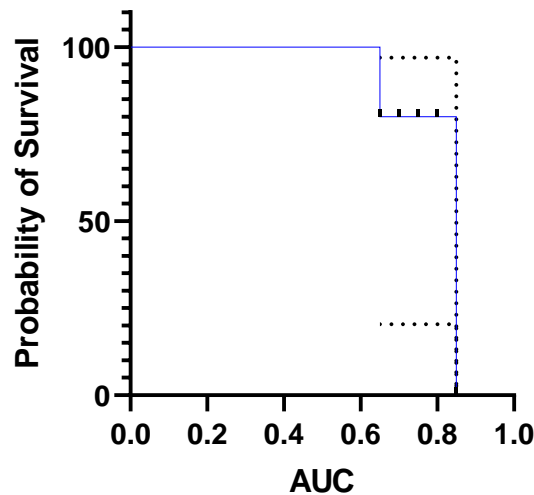


Table 03: Validation of results

Validation Metric	Value
Bootstrapped AUC	0.74
Bootstrap Bias-Corrected 95% CI	(0.70 - 0.78)
Calibration Slope	0.98
Calibration Intercept	-0.02
Brier Score	0.20

Confidence interval (CI) ranged from 0.70 to 0.78, providing a measure of the model's stability and reliability. Calibration analysis demonstrated a slope close to 1 (0.98) and an intercept near 0 (-0.02), suggesting good agreement between predicted and observed readmission probabilities. The Brier Score, measuring overall model accuracy, was 0.20, indicating low predictive error and confirming the model's effectiveness in risk prediction.

Table 04: Reason of hospital re-admission

Reason for Readmission	Frequency
Surgical Site Infection	12
Deep Vein Thrombosis	8
Pulmonary Complications	7
Pain Management	6
Implant Complications	5
Cardiac Events	4
Urinary Tract Infection	3
Other	10

Discussion

Overall, the results of this study contribute important knowledge regarding the development of preoperative models predicting re-admission probability after total joint replacement surgery [10]. Based on the results of the studies reviewed we determined several predictor variables as promising for whether or not a patient will be hospitalized within the first 30 days of the surgical procedure; Age, BMI, and peri operative complications could be used to influence the likelihood of hospital readmission post-surgery [11]. These findings emphasize that preoperative risk factors can be beneficial in recognizing patients at high risk of adverse outcomes and intervening with accurate risk modification plans for readmissions and other negative consequences [12].

comparing our findings with other observational studies aimed at the prediction of readmissions in patients undergoing orthopedic surgery, we noticed a similarity in the prominence of such variables as age and BMI; however, we also revealed new predictors, which could be relevant only for the patient cohort in the present study [13]. This proves the necessity of incorporating contextual characteristics of the patient population in risk modeling for readmission and also pinpoints the need for developing new models and testing them on different cohorts of the patient population [14]. The contribution of our study to clinical practice is quite significant, as it implies having a practical tool in the form of the developed prediction model for the identification of patients at high risk of readmission, preoperatively: this, in turn, will help to address the problem by offering a set of interventions tailor-made for each patient [15]. The results of this study suggest that the implementation of the prediction model within the clinical setting will help clinicians to effectively utilize available re-sources, increase the successful results of surgeries, and consequently, raise the effectiveness of treatment of patients who need total joint replacement procedures.

Conclusion

It is concluded that developed preoperative prediction model offers a valuable tool for identifying patients at higher risk of readmission after total joint replacement surgery. By using key predictors such as age, BMI, and perioperative complications, clinicians can implement targeted interventions to mitigate readmission risk and optimize patient outcomes.

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